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MODIS Validation, Data Merger and Other Activities Accomplished by the SIMBIOS Project: 2002-2003

Giulietta S. Fargion, Science Applications International Corporation, Maryland
Charles R. McClain, Goddard Space Flight Center, Greenbelt, Maryland

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

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Chapter 3

A Long-term Intercomparison of Oceanic Optical Property Retrievals from MODIS-Terra and SeaWiFS

Bryan A. Franz

Science Applications International Corporation, Beltsville, MD

3.1 INTRODUCTION

The work presented here is a comparative analysis of mean global and regional oceanic optical property retrievals from two independent, spaceborne ocean color sensors: the Sea-viewing Wide Field-of-view Sensor (SeaWiFS), and the MODerate resolution Imaging Spectroradiometer (MODIS). The SeaWiFS instrument has been in continuous operation since September of 1997, while the MODIS instrument, flying on the Terra spacecraft, has been collecting data since March of 2000. With the recent reprocessings of both instrument data sets, there now exists over three years of consistently processed, contemporaneous MODIS and SeaWiFS data available through the Goddard Distributed Active Archive Center (GDAAC), providing an unprecedented opportunity for intercomparison of global ocean color retrievals from two independent sources. This study looks at the temporal trends in several ocean color products derived from SeaWiFS and MODIS to evaluate the long-term relative stability between the two sensors and develop an understanding of their similarities and differences. The time-series analysis looks at variations in the mean value of normalized water-leaving radiance and chlorophyll products over the period from 12 March 2000 through 31 December 2002, for both global and regional geographic areas. Results are presented in the form of temporal overlays for common products, as well as product ratios as a function of time.

3.2 DATA SOURCES

The SeaWiFS data used in this analysis were standard, 9-km-resolution, Level-3 time-binned products from the 4th reprocessing, composited over 8-day periods. The MODIS data were standard, 4.6-km-resolution, Level-3 products from MODIS/Terra Oceans Collection 4.0, binned over the same 8-day periods. These Level-3, weekly data products for both SeaWiFS and MODIS are currently available from the GDAAC. It should be noted that some of the MODIS data used in this study are considered provisional. Due to the extensive, on-orbit characterization required to calibrate MODIS for ocean data processing, all data collected after the MODIS Oceans Collection 4.0 reprocessing (after March 19, 2002) are not fully corrected. Data collected prior to November 2000 are also considered provisional, due to the instability of the spacecraft and instrument during the first year of the Terra mission.

Several changes to the MODIS data were required to enable a bin-for-bin match-up with SeaWiFS. The first step was to convert the MODIS files to SeaWiFS-like Level-3 bin format. This was simply a reorganization of the HDF fields, as the SeaWiFS and MODIS formats use the same, sinusoidal binning approach. At this step, specific MODIS products were associated with standard SeaWiFS products, and any necessary unit conversions were performed. Only MODIS quality zero (QL=0) data were retained. The MODIS products chlor_a_2, nLw_412, nLw_443, nLw_488, and nLw_551, were associated with SeaWiFS products chlor_a, nLw_412, nLw_443, nLw_490, and nLw_555, respectively. The band associations are summarized in Table 3.1. Note that the algorithm for the chlor_a_2 product of MODIS (OC3M algorithm, O'Reilly et al., 2000) is very similar to that of the chlor_a product from SeaWiFS (OC4v4 algorithm, O'Reilly et al., 2000). The second step was to reduce the MODIS 4.6-km bin file to 9-km resolution, equivalent to standard SeaWiFS Level-3 bin resolution. This is effectively a 4-to-1 spatial averaging, weighted by the number of observations within each 4.6-km bin. The final step was to reduce the MODIS and SeaWiFS 9-km bin files to common bins. For a given 8-day period, only those bins that were filled in both the MODIS and the SeaWiFS files were retained in the final analysis. Filled bins are those for which one or more QL=0 retrievals were acquired.

3.3 SUBSET DEFINITIONS

With 8-day composited SeaWiFS and MODIS data products in an equivalent form, the data sets were further divided into several geographic subsets. Three global subsets were defined, corresponding to clear water, deep water, and coastal water.